EFFECT OF RESTORATIVE PROCEDURES AND MATERIALS ON THE DENTAL PULP

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Introduction

The pulp undergoes histopathological changes in response to irritation or destruction of dentin.

Pulp injury may result from anoxious stimuli due to several factors:

- Biological $\rightarrow$ dental caries
- Physical $\rightarrow$ restorative procedure
- Chemical $\rightarrow$ restorative material
1. **Biological Factors**

- Microorganisms and tissue breakdown products from dental caries may irritate and injure the pulp.
- Injury from dental caries is the most common cause of pulpal disease.
- Oral microorganisms may infect the pulp whenever it is exposed.
Dental Caries

It is a localized, progressive destruction of tooth structure and the most common cause of pulp disease.

Bacteria → product of bacterial metabolism → organic acid → proteolytic enzyme cause →

- destruction of E and D
- eliciting an inflammatory reaction
- infection of the pulp
Reaction that tend to protect the pulp against caries:

1. Decrease in permeability of the dentin
2. Formation of new dentin
3. Inflammatory and immune reactions
4. Dentin sclerosis
5. Reparative dentin
6. Dead tract in D

So the diagnosis of the extent of pulpal inflammation beneath a carious lesion is difficult.
2. **Physical Factors:**

**A- Effect of Local Anesthetics on the Pulp**

- The purpose of adding a vasoconstrictor to local anesthetic is to **potentiate and prolong the anesthetic effect by**:
  
1. reducing blood flow in the area in which the anesthetic is administered

2. decreasing pulpal blood flow for a short time
A significant reduction in blood flow during a restorative procedure could lead to → increase in the concentration of irritants accumulating within the pulp.

Therefore, whenever possible, it is advisable to use:

1. vasoconstrictor-free local anesthetics for restorative procedures or

2. stronger concentration of vasoconstrictor should be avoided during routine restorative procedure
**B-Cavity and Crown Preparation**

Cooking the pulp in its own juice described tooth preparation without proper coolant.

- Pulpal responses to cavity and crown preparation depend on many factors.
  1. Thermal injury
  2. Vibration
  3. Desiccation of dentin
  4. Pulp exposure
  5. Smear layer
  6. Remaining dentin thickness
  7. Agents for cavity cleansing
  8. Drying
  9. Sterilization
  10. Acid etching
Thermal Injury:

- Cutting of dentin with a rotating bur produces a considerable amount of frictional heat.
- If high temperatures are produced in deep cavities by continuous cutting without proper cooling → underlying pulp may be damaged.
- The tooth preparation without water spray caused a substantial decrease in pulpal blood flow.
Vibratory Phenomena

- Vibratory agitation may be produced by high-speed cutting procedures.
- Shock waves produced by vibration were particularly pronounced when the cutting speed was reduced.

Therefore, stalling of the bur by increased digital pressure on the handpiece should be avoided.
Desiccation of Dentin

Desiccation of dentin by cutting procedures or with a blast of air does not injure the pulp but may:

- lead to death of the odontoblast and to an inflammatory response
- odontoblast that have been destroyed as a result of desiccation are replaced by new odontoblast and 1 to 3 months reparative dentin is formed.
Remaining Dentin Thickness:

The distance between the floor of the cavity preparation and the pulp greatly influences the pulpal response to restorative procedures and materials.

2 mm of dentin thickness will protect the pulp.
Cavity Cleanser:

- Pulpal inflammation increased when acid cleansing agent (50% citric acid) used before restoration (increase the permeability of dentin and enhance penetration of the D by irritating substances)
Drying Agents: (ether-acetone)

- Should not be used in deep cavities → damage of odontoblast process and cells of the pulp
Cavity Sterilization: (phenol, silver nitrate)

Agents capable of destroying bacteria are also highly irritating the pulp so today are seldom used.
Acid Etching:

- It is also cleansing
- In very deep cavities may cause **pulpal injury**
3. **Chemical Factors**

Restorative Materials

- For many years it was believed that toxic ingredients in the materials were responsible for pulpal injury.

- Irritating materials such as ZinOxide-Eugenol (ZOE) → a very mild pulpal response

- Less toxic materials such as composite resins and amalgam → strong pulp response
Some of the properties of material might be capable of producing injury include:

- Acidity
- Absorption of water during setting
- Heat evolved during setting
- Poor marginal adaptation resulting in bacterial contamination
**Acidity:**

- The acid percent in restorative materials is neutralized by the dentin and dentinal fluid.
- Placement of an acidic material such as zinc phosphate at luting consistency in a deep cavity.

- **Toxic effect on the pulp**
- **Temperature rise** (it is not sufficient to produce tissue injury)
- **Moderate ↓ in P. blood flow** (due to chemical or exothermal effects of the cement)
Absorption of Water:

No relationship between the hydrophilic properties of materials and their effect on the pulp.
Bacterial Contamination:

- Dental materials do not adapt to tooth structure to provide hermetic seal.
- So bacterial growing beneath restorations will create toxic product which will diffuse through dentinal tubules then evoke inflammatory reaction to the pulp.
- Bacteria become established under restorative materials that do not provide an adequate marginal seal. [adequate cavity liner or cement base should be applied to seal dentinal tubules]
Material that has a different coefficient of thermal expansion than tooth structure – (change in temperature) is likely to produce gaps between the materials and cavity walls.

- ZOE
- CaOH
- Polycarboxy cement
- Zn Ph Cement
- Restorative resin
- Silicate cement

Inhibit bacterial growth (have antibacterial properties)

Injure the pulp (lack antibacterial properties)
<table>
<thead>
<tr>
<th>ZOE</th>
<th>Z. Phosphate Cement</th>
<th>Z. Polycarboxylate Cement</th>
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</thead>
</table>
| ▪ Temporary filling  
 ▪ Temporary. and perm cementation  
 ▪ Pulp capping  
 ▪ Cement base  
 ▪ Anesthetic properties  
 ▪ Adapt very closely to dentin  
 ▪ Avoided in very deep cavity | ▪ As a liner not to be used [severe pulp reaction] due to acidity  
 ▪ As a cement base under Amalgam. [resist stress of mastication]  
 ▪ Doesn’t adapt to the margin [pulp irritation] | ▪ Well tolerated by the pulp  
 ▪ Adapt well to dentin  
 ▪ Has bacteriocidal qualities |
<table>
<thead>
<tr>
<th>Restorative Resin</th>
<th>GIC</th>
<th>Amalgam</th>
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<tbody>
<tr>
<td>Adaptation to the margin improved by:</td>
<td>Well tolerated by the pulp</td>
<td>Doesn’t adapt to the margin [sensitivity]</td>
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<tr>
<td>Acid etching</td>
<td>Good marginal seal</td>
<td>Inflammation to the pulp [high mercury content] → CaOH</td>
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<tr>
<td>Bevel enamel</td>
<td>Should be used with liner or base</td>
<td>Cavity varnish or base is recommended to seal dentinal tubules. and prevent postoperative discomfort</td>
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<tr>
<td>Bonding agent</td>
<td></td>
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<tr>
<td>Unlined composite resins harmful to pulp</td>
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<tr>
<td>(Bacterial contamination beneath restoration)</td>
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<td></td>
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<tr>
<td>So base containing CaOH will provide good protection against bacteria</td>
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Varnish

- Protect the pulp \textit{(controversial)}
- 2-3 coats may not prevent gap or prevent bacterial leakage and growth of bacteria
- Act as a barrier to toxic effect of restorative
- Varnish ↓ microleakage beneath high-copper spherical alloy restorative material
Heat of Polishing

Temperature $\uparrow$ in the p. more than 20°C when amalgam restoration were polished continuously with prophylactic cups.

Polishing appliances made of rubber created higher temperatures than cup brushes.

Continuous polishing and high speed $\rightarrow \uparrow$ heat than intermittent polishing and low speed.
Prevention

- **Cutting procedure**: use light, intermittent cutting, an efficient cooling system, and high speeds of rotation.
- **Avoid desiccating the dentin**: do not overdry the cavity preparation.
- **Do not apply irritating chemicals** to freshly cut dentin.
- **Choose restorative materials carefully**, considering the physical and biologic properties of the material.
Do not use caustic cavity sterilizing agents.

Assume that all restorative materials will leak. Use a cavity liner or base to seal the openings of exposed dentinal tubules.

Do not use excessive force when inserting a restoration.

Employ polishing procedures that do not subject the pulp to excessive heat.

Establish a patient recall system that ensures periodic evaluation of the status of pulps that have been exposed to injury.
THANK YOU